Mr Rothberg

WORK PLAN

FOR

- WATERSHED PROTECTION
- FLOOD PREVENTION
- AGRICULTURAL WATER MANAGEMENT

CROOKED LAKE BAYOU WATERSHED

MISSISSIPPI COUNTY, ARKANSAS

January 1964

4-18825 3-64

WATERSHED WORK PLAN AGREEMENT

between the

Mississippi County Soil and Water Conservation District
Local Organization

Drainage District No. 17 of Mississippi County, Arkansas
Local Organization

_____
Local Organization

_____

_____

State of Arkansas
(hereinafter referred to as the Sponsoring Local Organization)

and the

Soil Conservation Service
United States Department of Agriculture
(hereinafter referred to as the Service)

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organization for assistance in preparing a plan for works of improvement for the Crooked Lake Bayou Watershed, State of Arkansas under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress; 68 Stat. 666), as amended; and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to the Service; and

Whereas, there has been developed through the cooperative efforts of the Sponsoring Local Organization and the Service a mutually satisfactory plan for works of improvement for the Crooked Lake Bayou Watershed, State of Arkansas, hereinafter referred to as the watershed work plan, which plan is annexed to and made a part of this agreement;

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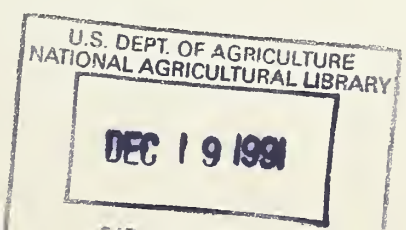

Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organization and the Secretary of Agriculture, through the Service, hereby agree on the watershed work plan, and further agree that the works of improvement as set forth in said plan can be installed in about five years.

It is mutually agreed that in installing and operating and maintaining the works of improvement substantially in accordance with the terms, conditions, and stipulations provided for in the watershed work plan:

1. The Sponsoring Local Organization will acquire without cost to the Federal Government such land, easements, or rights-of-way as will be needed in connection with the works of improvement. (Estimated cost $ 59,164.)

2. The Sponsoring Local Organization will acquire or provide assurance that landowners or water users have acquired such water rights pursuant to State law as may be needed in the installation and operation of the works of improvement.

3. The percentages of construction costs of structural measures to be paid by the Sponsoring Local Organization and by the Service are as follows:

Works of Improvement	Sponsoring Local Organization (percent)	Service (percent)	Estimated Construction Cost (dollars)
Pumping Plant, Drainage Mains and Laterals, Levee, and Water Control Structures	20.58	79.42	931,511

4. The percentages of the cost for installation services to be borne by the Sponsoring Local Organization and the Service are as follows:

Works of Improvement	Sponsoring Local Organization (percent)	Service (percent)	Estimated Installation Service Cost (dollars)
Pumping Plant, Drainage Mains and Laterals Levee, and Water Control Structures	0	100	232,003

5. The Sponsoring Local Organization will bear the costs of administering contracts. (Estimated cost $ 4,222 .)

6. The Sponsoring Local Organization will obtain agreements from owners of not less than 50% of the land above each reservoir and floodwater retarding structure that they will carry out conservation farm or ranch plans on their land.

7. The Sponsoring Local Organization will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the watershed work plan.

8. The Sponsoring Local Organization will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.

9. The Sponsoring Local Organization will be responsible for the operation and maintenance of the structural works of improvement by actually performing the work or arranging for such work in accordance with agreements to be entered into prior to issuing invitations to bid for construction work.

10. The costs shown in this agreement represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation of works of improvement will be used.

11. This agreement does not constitute a financial document to serve as a basis for the obligation of Federal funds, and financial and other assistance to be furnished by the Service in carrying out the watershed work plan is contingent on the appropriation of funds for this purpose.

    Where there is a Federal contribution to the construction cost of works of improvement, a separate agreement in connection with each construction contract will be entered into between the Service and the Sponsoring Local Organization prior to the issuance of the invitation to bid. Such agreement will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

12. The watershed work plan may be amended or revised, and this agreement may be modified or terminated, only by mutual agreement of the parties hereto.

13. No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.

Mississippi County Soil and Water Conservation District
Local Organization

By Wm. H. Wyatt

Title Chairman

Date April 16, 1964

The signing of this agreement was authorized by a resolution of the governing body of the Mississippi County Soil and Water Conservation District
Local Organization

adopted at a meeting held on April 9, 1964

Clyde L. Whittle
(Secretary, Local Organization)

Date April 16, 1964

Drainage District No. 17
of Mississippi County, Arkansas
Local Organization

By Chas Lose

Title Chairman

Date April 16, 1964

The signing of this agreement was authorized by a resolution of the governing body of the Drainage District No. 17 of Mississippi County, Arkansas
Local Organization
adopted at a meeting held on April 16, 1964

(Secretary, Local Organization)

Date April 16, 1964

Local Organization

By _____

Title _____

Date _____

The signing of this agreement was authorized by a resolution of the governing body of the _____
Local Organization
adopted at a meeting held on _____

(Secretary, Local Organization)

Date _____

Soil Conservation Service
United States Department of Agriculture

By _____
Administrator

Date _____

WORK PLAN

FOR

WATERSHED PROTECTION, FLOOD PREVENTION, AND AGRICULTURAL WATER MANAGEMENT

CROOKED LAKE BAYOU WATERSHED
Mississippi County, Arkansas

Prepared Under the Authority of the
Watershed Protection and Flood
Prevention Act, (Public Law
566, 83rd Congress, 68
Stat. 666), as amended

Prepared By:

Mississippi County Soil and Water Conservation District
(Cosponsor)

Drainage District No. 17 of Mississippi County, Arkansas
(Cosponsor)

With Assistance By,

U. S. Department of Agriculture
Soil Conservation Service

January 1964

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WATERSHED WORK PLAN

CROOKED LAKE BAYOU WATERSHED
Mississippi County, Arkansas
January 1964

SUMMARY OF PLAN

This work plan for watershed protection, flood prevention, and drainage for the Crooked Lake Bayou watershed was prepared by the Mississippi County Soil and Water Conservation District and Drainage District No. 17 of Mississippi County, Arkansas, as sponsoring local organizations. Technical assistance was furnished by the United States Department of Agriculture, Soil Conservation Service.

The Crooked Lake Bayou watershed is in the northeast corner of Mississippi County, Arkansas. The 18,700-acre project is bounded on the west and south by natural divides, and on the north by the Arkansas state line (figure 3). The Mississippi River Levee is the eastern boundary. An additional area of 2,350 acres in Pemiscot County, Missouri, drains through the northwestern part of the watershed.

There are about 1,660 residents in the area, all rural. The communities of Armorel, Number Nine, Barfield, Hickman, and Huffman are within the project boundaries. There are approximately 120 farm units, averaging approximately 160 acres each.

The present land use for the watershed is: cropland, 96.2 percent; woodland, 0.2 percent; idle, 0.6 percent; and miscellaneous, 3.0 percent. All land within the watershed is privately owned.

Sediment and erosion are not significant watershed problems.

Excessive soil moisture conditions affect 18,210 acres. About 17,520 acres of cropland will be benefited by the installation of the project.

The project is in accordance with the Rural Areas Development concept and will help accomplish the national goals for this program.

The project is consistent with the President's directive and the Department of Agriculture's policy on soil and water conservation and rural area development.

The installation of this plan will furnish jobs for some of the underemployed and unemployed people in the area and will tend to stabilize conditions which would contribute favorably to the furtherance of the farm-family pattern of agriculture.

The work plan proposes works of improvement for the watershed to be accomplished during a 5-year installation period at a total estimated cost of $1,545,162. Of this total, $1,001,072 will be borne by Public Law 566 funds and $544,090 will be borne by other sources.

Nearly all of the watershed is covered by standard soil surveys. Approximately 66 percent of the watershed is covered by basic conservation plans developed with the local soil and water conservation district. About 39 percent of the needed land treatment measures have been applied. The cost of land treatment measures applied to date is estimated at $203,821 (table 1A).

Landowners and operators will install additional land treatment measures which have a measurable effect on the reduction of floodwater damage and problems associated with agricultural water management. The cost of these measures is estimated at $318,262. This includes $11,382 of Public Law 566 funds to provide accelerated technical assistance during the installation period, $10,355 for technical assistance under the Public Law 46 going program, and $296,525 from other sources.

A concerted effort has been made by the sponsors to solve watershed problems with structural measures. During the period from 1950 to 1962, an estimated $168,640 was spent for this purpose. Structural works of improvement proposed in this plan will consist of approximately 37.7 miles of new or enlarged drainage mains and laterals, two water control structures, 1,130 feet of levee, and a pumping plant capable of discharging 600 c.f.s., at a static head of 13 feet. The total estimated installation cost of these measures is $1,226,900. The cost will be shared $971,809 by Public Law 566 funds and $255,091 by other sources.

The average annual benefits accruing to structural measures are distributed as follows:

Flood Prevention	$68,046
Drainage	47,602
Secondary Benefits	16,408
Total	$132,056

The ratio of average annual benefits to average annual costs of structural measures ($83,211) is 1.6 to 1.

The cost of applying planned land treatment measures will be borne by the owners and operators of land with assistance from Federal and State programs.

A subdistrict to be known as Subdistrict No. 2 of Drainage District No. 17 of Mississippi County, Arkansas, will be formed to carry out the local responsibilities for the installation and operation of all structural measures. The subdistrict will have the powers of taxation and eminent domain. The parent district, Drainage District No. 17, has sent a letter

of intent to borrow to the Farmers Home Administration. Funds obtained from the loan will be used to finance the local share of project cost. Revenue from assessments on benefited lands will be used to repay the loan and for operation and maintenance of structural measures.

Land treatment measures will be maintained by landowners and operators cooperating with the soil and water conservation district. The structural measures will be operated and maintained by Subdistrict No. 2. The estimated annual operation and maintenance cost for structural measures is $12,750.

DESCRIPTION OF THE WATERSHED

Physical Data

The Crooked Lake Bayou watershed is in the northeast corner of Mississippi County, Arkansas. The 18,700-acre project is bounded on the west and south by natural divides, and on the north by the Arkansas state line (figure 3). The Mississippi River Levee is the eastern boundary. An additional area of 2,350 acres in Pemiscot County, Missouri, drains through the northwestern part of the watershed. The communities of Armorel, Number Nine, Barfield, Hickman, and Huffman are within the watershed. Blytheville, the county seat of Mississippi County, Arkansas, is six miles to the west.

Ditch No. 38 (figure 3) heads near the southeast corner of the watershed and flows westward toward Crooked Lake, an oxbow near Armorel. Ditch No. 38 leaves Crooked Lake just north of Armorel and flows northward to the community of Number Nine. At this place, it enters Pemiscot Bayou (Ditch No. 29, the watershed outlet). Ditch No. 29 flows westerly about 15 miles to the Little River Floodway.

The only major tributary to Ditch No. 38 is Ditch No. 42. It enters Ditch No. 38 one-half mile south of Number Nine. Ditch No. 45 which drains the Missouri portion of the watershed empties into Ditch No. 42 about 1-3/4 miles southeast of Number Nine.

The watershed is located in the alluvial valley of the Mississippi River. The topography is typical of a flood plain of a large river. The general slope of the land is from the northeast to the southwest. Elevations range from about 260 feet to about 245 feet above mean sea level. Although the area is essentially a plain, the topography includes low sandy ridges, oxbow lakes, and shallow depressions of abandoned stream channels. The two largest of these depressions have been farmed for years, but they are subject to flooding from excess runoff from 4,102 and 5,917 acres, respectively.

The watershed is in the Bottomland Land Resource Area. These soils are alluvium of Recent Age. There are about 18,210 acres of soils mapped as Sharkey, Tunica and Mhoon series. These soils are deep and very slowly permeable. There are about 490 acres of deep permeable soils. These

occur in small areas scattered throughout the very slowly permeable soils.

All land within the watershed is privately owned.

The present land use for the watershed is as follows:

Land Use	Acres	Percent
Cropland	17,995	96.2
Woodland	30	0.2
Idle	115	0.6
Miscellaneous 1/	560	3.0
Total	18,700	100.0

1/ Includes roads, farmsteads, channels, Crooked Lake, etc.

The crop distribution on the 17,995 acres in cultivation is as follows: cotton, 41.1 percent; soybeans, 53.5 percent; alfalfa, 5.4 percent; and wheat, 4.1 percent. Most of the wheat acreage is double-cropped, being followed by soybeans.

Based on 36 years of record (1927 through 1962), the mean annual rainfall is 47.47 inches. The maximum recorded annual rainfall of 81.43 inches occurred in 1957. The minimum was 23.18 inches in 1941. The gage is located in Blytheville, Arkansas, six miles west of the watershed.

The mean rainfall by months, in inches, is as follows:

January	5.45	July	3.66
February	4.33	August	3.38
March	5.00	September	3.21
April	4.01	October	2.80
May	4.17	November	3.93
June	3.29	December	4.24

Mean temperatures range from 40.5 degrees Fahrenheit in January to 81.6 degrees in July. The minimum temperature of record is 9 degrees below zero and the maximum is 109 degrees. The normal frost-free period of 217 days extends from March 28 to October 31.

Water for irrigation and domestic use is obtained from wells. Additional irrigation water is obtained from Crooked Lake. Irrigation is not common in the watershed except during periods of extreme drought.

Economic Data

The economy of the watershed depends entirely on intensified agricultural production. The principal crops are cotton and soybeans. Smaller acreages are in alfalfa and wheat. Ninety-eight percent of the value of all farm

products sold is from the sale of crops. This percent has remained constant since 1949, according to the Census of Agriculture.

County agricultural statistics indicate that significant upward trends have occurred both in the average size of farm units and the value of land and buildings. Since 1954, the average size of farm units increased from 92 to 184 acres, and the value of land and buildings per farm unit increased from $17,010 to $53,590. Farm tenancy shifted slightly from 1954 to 1960 with full owners increasing 3.1 percent, part owners increasing 8.6 percent, and managers increasing 0.8 of 1 percent. A corresponding decrease occurred in farm tenants.

There are 120 farm units in the watershed with an average size of approximately 160 acres. These farm units involve 154 ownership parcels. Ownership is divided as follows: 18 percent have less than 40 acres; 40 percent range from 40 to 80 acres; 19 percent range from 80 to 160 acres; 18 percent range from 160 to 320 acres; and 5 percent are larger than 320 acres. The Armorel Planting Company, with headquarters at Armorel, manages 3,200 acres within the watershed. Another large unit, with headquarters at Number Nine, has managerial responsibility for large acreages through ownership, leasing, and subleasing arrangements. Many of the smaller ownerships, some of which have absentee owners, are combined with other owner-operated farms to form economic units.

The population of the watershed is 1,660, all rural.

Blytheville, population 20,800, county seat of Mississippi County, serves as the primary commercial center for watershed inhabitants. It also provides the needed educational and recreational facilities.

Armorel, Number Nine, Barfield, Hickman, and Huffman, small communities within the watershed, provide items of daily necessity to their trade areas and to migrant agricultural workers. Populations of these communities are stable.

The watershed is adequately served by 17 miles of state and 60 miles of county roads. The network of roads makes all areas of the watershed readily accessible. Rail facilities are provided by the St. Louis & San Francisco Railroad, with loading facilities at Blytheville.

Recent developments which will affect the agricultural economy are the establishment of additional storage and shipping facilities for soybeans. One unit is located at Barfield, the other near Huffman. These facilities will permit shipment of soybeans by river barge to Memphis, Tennessee, for storage and processing and will provide a saving to farmers in reduced hauling expenses and freight costs. In addition, they will improve harvest conditions by permitting more efficient operation of harvesting equipment. This is particularly important in view of the increased production resulting

from advancement in technology and increased land development due to improved drainage. Plans for facilities to store and ship cotton by river barge are not anticipated because present facilities for processing and transferring cotton are adequate.

Alfalfa, an increasing crop enterprise in the watershed, has gained popularity due to the low labor requirements and the cash provided by the sale of the crop during the spring and summer. The income from alfalfa is used toward payment for labor and operation expenses for other crops. Its growth, however, is limited to areas of well-drained soils. Also contributing to the increase in acreage is the reduced fertilizer requirements for other crops once rotated and the fact that harvest is not hampered materially by wet conditions. Alfalfa is processed into pellets at the dehydrator near Number Nine and is shipped to the southeastern United States primarily for supplement to livestock feed.

Land Treatment Data

The watershed is served by the Soil Conservation Service work unit at Blytheville which is assisting the Mississippi County Soil and Water Conservation District.

Standard soil surveys are nearly complete and do not impose a limit on the application of needed land treatment measures. Approximately 66 percent of the land within the watershed is covered by 36 basic conservation plans developed in cooperation with the soil and water conservation district. About 39 percent of the needed land treatment measures have been applied. Installation of on-farm drainage systems has been hampered by inadequate outlets. Those systems that have been installed have not been fully effective for the same reason. The application of other needed conservation measures has lagged because of the inadequate development of the drainage practices.

WATERSHED PROBLEMS

Floodwater Damage

Flooding occurs on 18,210 acres within the watershed. The flood problem on most of the watershed (16,861 acres) cannot be separated from the drainage problem which exists on the same area. Flooding occurs frequently in the watershed causing moderate to severe damage to crops. Small overflows may occur several times annually delaying normal farming practices and damaging crops. Late winter and spring floods are of particular significance. These floods delay cultural practices.

Flood problems on the two shallow depressions are aggravated because of the frequent and prolonged inundation that takes place and causes heavy damage. The area inundated in these depressions by the runoff from a

20-year frequency storm is estimated at 1,349 acres. The depressions are designated in figure 3 as Reach 1 (705 acres) and Reach 2 (644 acres). Present land use in these areas is 88 percent cropland, 8 percent idle, 2 percent woods, and 2 percent miscellaneous.

Property subject to damage in the depressions includes agricultural land and an estimated one-half mile of county roads and several miles of private roads and bridges. Damage to private roads and bridges is of minor significance; however, wet conditions interrupt their use, causing cultural practices to be delayed. Property other than crops and roads and bridges are not damaged in these areas.

The period of damage to crops growing in the evaluation reaches is from April through November. This period was used for the evaluation of crop damage in the evaluation reaches.

Major floods which inundate more than half of the evaluation reaches occur on the average of about once every two years. A two-year flood would cause an estimated $15,750 damage to a growing crop under present conditions (1962 prices).

The most damaging flood in recent years occurred on May 22 and 23, 1957 when all of the 1,349-acre area was inundated. This flood followed the flood of April 4 and 5, 1957 which inundated an estimated 550 acres. Crop damage, under the present state of development, is estimated to be $37,590 from this flood. Annual floodwater damages to crops is estimated to average $24,176.

Damage to county roads is most significant at two locations in Reach 1. Damage results from an unstable roadbed condition due to saturation which exists when floodwater encroaches on the roadbeds for prolonged periods. Floods which completely inundate the roads erode the gravel surface even though the water velocities are low. Removal of gravel is most severe at the point where water recedes below the road surface. Road and bridge damage is estimated to average $2,723 annually.

Roadbeds remain subject to damage for prolonged periods due to the saturation; therefore, all travel must use alternate routes if damage is to be kept to a minimum. School buses and mail service, as well as normal farm travel, are interrupted. Increased expenses associated with alternate routing is a significant item, especially for farmers whose interests are on both sides of the depressions. The road paralleling the Mississippi River Levee is the principal alternate route. These indirect damages are expected to average $2,963 annually.

Sediment and Erosion Damage

Sedimentation and erosion are not significant watershed problems except where land voiding occurs at ditch inlets, and the resulting sediment

accumulation affects ditch capacities. The present trend of installing pipe drops at these inlets into the ditch systems is reducing the problem.

Problems Relating to Agricultural Water Management

Drainage is needed on 18,210 acres. Of this area, 1,349 acres is in the two depressed areas.

In the area outside the two depressions (17,351) only 490 acres do not require drainage. This area is level to gently undulating with small areas of sandy soils interspersed within the predominantly wet clayey soils. Fifty-four percent of the runoff from this area passes through the depressions before reaching the outlet. All of the area is in crop production. Land use in this area is 42 percent soybeans, 49 percent cotton, 6 percent alfalfa, 3 percent miscellaneous, and 4 percent wheat.

The principal problem in this area is one of inadequate outlets for removal of excess water. Cropland for the production of cotton, alfalfa, and wheat is limited to the higher, better-drained soils, while the lower wet areas must be planted to late-variety soybeans. Wet conditions during the early spring prevent the desired crop rotations and increase production costs due to inadequate seedbed preparation and weed infestation.

Seepwater causes some damaging effect to crops in the area outside the depressions. It usually becomes a problem during periods when stages on the Mississippi River are higher than normal. Seepwater appears in soils which have sand deposits in their profiles. These sandy soils are interspersed with other wet soils throughout the area. The entrance of seepwater into the sandy soils often prevents timely cultural practices and sometimes prohibits the use of land for early spring crops. The seepage problem is not great enough to justify the installation of measures to correct the problem.

Watershed problems have been aggravated by the entrance of floodwater from the upper reaches of Bell Fountain Ditch into Pemiscot Bayou. Bell Fountain Ditch is located in Pemiscot County, Missouri. Floodwater flows over the state line road about one mile north of Number Nine during periods of high rainfall, occupies channel capacity and retards the flow of floodwater from the watershed. Interviews with local residents revealed that this occurs on the average of once in five years.

Efforts to improve outlet conditions to drain the wet soils and reduce flooding have been continuous (table 1A). Crop production, although risky, has become possible in the depressions, and substantial increases in yields have been experienced on land where adequate farm drainage systems have been installed. However, adequate farm drainage systems on some of the land have aggravated the flood problem on other land, particularly in the two depressions. High stages in the Little River Floodway limit the discharge from

Crooked Lake Bayou, Ditch No. 38, and Pemiscot Bayou, Ditch No. 29; consequently floodwater persists and damages crops. In addition, the capacity of Ditch No. 38 is not adequate. Unstable soils near the outlet of Ditch No. 38 have prevented the correction of this situation.

PROJECTS OF OTHER AGENCIES

The Corps of Engineers has provided an improved outlet for the Bell Fountain Ditch and Ditch No. 29 by the enlargement of a new outlet through the borrow pit ditches bordering the east levee of the Little River Floodway (vicinity map, figure 3). The project was authorized by the Flood Control Act dated May 17, 1950, Public Law 516, and amended by the Flood Control Act of 1958. Spoil from the Corps of Engineers outlet ditch was placed on the west side of the ditch and is continuous beginning at the Elk Chute Levee and extending downstream. The improvements completed in 1963 form a backwater levee that reduces stages in Bell Fountain Ditch and the Ditch No. 29. The channel improvement is expected to provide the necessary outlet for Bell Fountain Ditch. The exchange of water that has occurred between the existing channels of the Pemiscot County system and the Mississippi County system, approximately one mile north of the Crooked Lake Bayou Watershed outlet, is expected to be an infrequent occurrence in the future and will not affect project evaluation.

The effect of the Corps' project on the discharge capability of Ditch No. 29 (the watershed outlet) is reduced due to the flat gradients existing in Ditch No. 29.

BASIS FOR PROJECT FORMULATION

The sponsors provided the basis for project formulation by reviewing present watershed problems. These problems of flooding and inadequate facilities for drainage have prevented agriculture in the watershed from reaching a needed level of development. The past efforts for providing an adequate gravity outlet have convinced the sponsors that pumping facilities are required to solve their problems.

Installation of some of the needed land treatment measures of land smoothing, land grading, drainage field ditches, and drainage laterals on individual farms add to the existing problem of flooding caused by an inadequate outlet. A system is needed to remove floodwater and excessive moisture if needed cover, green manure, and crop residue use are to be employed in a good conservation cropping system. Consequently, the interdependence of the needed land treatment measures and structural measures is recognized. The sponsors and the Soil Conservation Service agreed upon the following objectives:

1. Provide needed land treatment measures which will increase the efficiency of land use, obtain maximum benefits from the proposed improvements, and allow for land use within its capabilities and needs.

2. Provide for the removal of the runoff from an approximate two-year frequency storm in a 24-hour period.

3. Provide needed structural measures to adequately manage for agricultural purposes the rainfall which occurs in the watershed. The locations of these structural measures are to afford equal opportunity of use to all farmers in the watershed.

4. Provide sufficient capacity in Ditch Number 45 so that future channel improvement in Missouri upstream from the watershed area will not adversely affect the project. The sponsors expect to reach a mutually satisfactory agreement with interests in Missouri on reimbursement for an equitable share of the common costs before treatment is started on the Missouri portion.

The proposed works of improvement will solve adequately the watershed problems and meet the objectives of the sponsors. These measures are the most practical and economical to install.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures

The Mississippi County Soil and Water Conservation District has been conducting a conservation program on cooperating farms of the watershed, beginning in October 1956. This program, based upon the use of each acre of agricultural land within its capabilities and its treatment in accordance with its needs for protection and improvement in the chosen land use, is an essential part of watershed protection. The extent of needed land treatment measures which have been applied to date within the watershed represent an expenditure by landowners and operators of approximately $204,000 (table 1A).

The accelerated application and continued maintenance of land treatment measures is important. Without them, the installation of other work plan features could not produce the expected benefits. For this reason, in addition to the presently available technical assistance, $11,382 will be made available from Public Law 566 funds to accelerate the planning of these practices.

Table 1 includes estimates of the acreage in cropland which will receive accelerated treatment during the project installation period. Roads, ditches, homesteads, levees, and community development constitute the only other important land use in the watershed.

Needed measures will be established by landowners and operators in cooperation with the going soil and water conservation program. About 16,000 acres of cropland will be treated with a combination of measures, including

cover and green manure crop and crop residue use in a conservation cropping system. Grasses and legumes will be used in rotation on about 17 percent of the cropland. Practices to permit the best use and removal of rainfall, such as drainage mains and laterals, drainage field ditches, land smoothing, row arrangement, spoil bank spreading, and structures for water control will be installed as needed on about 8,500 acres of cropland.

Structural Measures

The structural measures to be installed are a pumping plant, drainage mains and laterals, a levee, and water control structures. All structural measures will serve flood prevention and drainage purposes.

The pumping plant will consist of three 54 inch axial or mixed-flow pumps powered by three 600 horsepower diesel engines. Each of the pumps has a required design capacity of 90,000 gallons per minute when operating at a static head of 13 feet. The plant is designed to remove about 1.7 inches of runoff in 24 hours from the 13.2 square mile drainage area upstream from water control structure No. 1. When the connecting ditch is operating at design capacity (150 c.f.s.) the removal from this area will be reduced to 1.28 inches of runoff in 24 hours. The estimated installation cost of the pumping plant is $796,199. Additional physical pumping plant data are shown in table 3A and figures 1, 2, and 3.

Approximately 37.7 miles of channels will be installed. The system will include 31.7 miles of drainage mains and laterals, 2.5 miles of drainage mains designed to function also as inlet and outlet channels for the pumping plant, and 3.5 miles of drainage laterals designed to connect Reach 1 and Reach 2. The estimated installation cost of the drainage mains and laterals is $369,551.

The drainage mains and laterals, with appurtenances, will be installed to provide outlets for all of the farms needing drainage. Approximately 140 grade stabilization structures will be installed, as appurtenances, in ditches and side drains where needed for grade stabilization and erosion control. The drainage mains and laterals will, for the most part, follow existing ditches and natural drains. Most of the ditches will require resectioning to provide the desired level of protection. Ditch No. 79 and about one-half mile of the upper end of ditch No. 45 are new ditches.

Ditch No. 43A will be installed as a relocation of existing Ditch No. 43. The existing ditch crosses a sand ridge where ditch dimensions cannot satisfactorily be maintained and does not provide an adequate outlet for the area. The drainage district has made several attempts at deepening Ditch No. 43 but has failed because of the unstable soil conditions that exist at the required depth. Ditch No. 43A will provide an adequate outlet for the area and is located so as to eliminate the grade stabilization problem.

The drainage mains and laterals were designed using the runoff formula $Q = 45M^{5/6}$ where "Q" represents the runoff in cubic feet per second and "M" represents the drainage area in square miles. Each ditch and its appurtenant structures has been planned to serve more than one landowner. No ditch was planned for the primary purpose of bringing new land into agricultural production.

The inlet and outlet channels are planned to carry the designed capacity of the pumping plant. The outlet channel will cut through an existing levee which was once the main river levee, and discharge into an old river run approximately 1,500 feet from its outlet into the Mississippi River.

A levee will be built to protect the area south of the outlet channel from flooding through the cut in the old levee when the river is at high stages. The new levee is planned to be constructed to an elevation equal to that of the old levee. The estimated installation cost of the levee is $53,727.

A connecting ditch is planned to join Reaches 1 and 2. The ditch, together with the water control structures, is designed to equalize the protection provided the two segments of the watershed and to insure that the benefits claimed for each segment will be attained. When the natural outlet for the watershed is blocked by high-water stages, these measures will provide access to the pumping plant for excess water from all parts of the watershed. At other times, they will provide disposal facilities for Reach 1 comparable to those provided for Reach 2. The connecting ditch includes Ditch Nos. 49 and 50 and a new one-mile section joining them. The ditch is designed to carry 150 c.f.s. at the 5-year frequency high water elevation in Reach 2.

Two water control structures will be installed. Water Control Structure No. 1 will be installed in Ditch No. 38 to prevent runoff from Reach 1 from outletting into the lower section of Ditch No. 38 during certain periods and causing it to be inadequate as a gravity outlet for Reach 2. Water Control Structure No. 2 will be installed in the connecting ditch to prevent runoff from Reach 2 from outletting into Reach 1 under normal conditions. Both water control structures will be operated in accordance with the operation agreement. The estimated installation cost of the water control structures is $7,423.

The estimated total installation cost of the structural measures is $1,226,900.

Detailed information on quantities, costs, and design features is given in tables 1, 2, 3, 3A, and 3B. The locations of all structural measures are shown on the project map (figure 3).

EXPLANATION OF INSTALLATION COSTS

The total installation cost of the project is estimated to be $1,545,162 of which $983,191 will be paid from Public Law 566 funds and $561,971 by other funds. Included in the total project costs are land treatment

measures, $318,262, and structural measures, $1,226,900.

Land treatment costs will be shared $11,382 by Public Law 566 funds for technical assistance to accelerate planning of the installation of the planned land treatment measures and $306,880 for the installation of these measures by other funds. The $306,880 from other funds includes $10,355 for technical assistance from Public Law 46 funds under the going program and $296,525 from local interests for the installation of the measures, including any reimbursement from ACP funds.

Structural measures cost will be shared $971,809 by Public Law 566 funds and $255,091 by other funds. The Public Law 566 funds will pay a share of the construction cost, $739,806, and all costs of installation services, $232,003. Other funds consist of $4,222 for administration of contracts, $21,964 for easements, land values, and legal fees, $37,200 for road and bridge restoration and $191,705 for construction costs.

The engineer's cost estimate and contingency allowance is considered realistic and provides a reasonable margin to cover unexpected costs.

Costs for all structural measures were allocated to purpose in accordance with Part I, Chapter 1, Paragraph 1132.212 of the Watershed Protection Handbook. The overall allocation of costs for structural measures is $721,908 (about 58.84 percent) to flood prevention and $504,992 (about 41.16 percent) to drainage (table 2A).

One hundred percent of all construction costs allocated to flood prevention, 50 percent of the construction costs allocated to drainage and 100 percent of all installation service costs will be paid from Public Law 566 funds.

Other funds will pay 100 percent of the costs for administration of contracts, land, easements, legal fees, rights-of-way, and 50 percent of construction costs allocated to drainage.

The schedule of obligations for the 5-year installation period, including both land treatment and structural measures, is as follows:

Schedule of Obligations

Fiscal Year	Measures	Public Law 566 Funds	Other Funds	Total
		(dollars)	(dollars)	(dollars)
First	Land Treatment	2,300	61,000	63,300
	Drainage Mains and Laterals, Levee, and Water Control Structures, Part of the Installation Services for the Pumping Plant ($60,000)	364,215	126,486	490,701
Second	Land Treatment	2,300	62,000	64,300
	Pumping Plant	607,594	128,605	736,199
Third	Land Treatment	2,300	62,000	64,300
Fourth	Land Treatment	2,300	62,000	64,300
Fifth	Land Treatment	2,182	59,880	62,062
	TOTAL	983,191	561,971	1,545,162

Adjustments in the schedule may need to be made from year to year in view of accomplishments actually made and if considered mutually desirable. The schedule reveals the amount of Public Law 566 and other funds obligated each year during the installation period.

EFFECTS OF WORKS OF IMPROVEMENT

Ditch No. 29 will provide an adequate gravity outlet for only about 19.7 square miles of the watershed. The pumping plant will provide an outlet for the remaining 13.2 square miles and afford about the same level of protection as the gravity outlet system for floods up to the two-year frequency. A comparable level of protection for larger floods will be assured by the installation of the connecting ditch and water control structures joining the gravity outlet and pumped outlet portions of the watershed.

The reduction in the discharge into Ditch No. 29 by the operation of the pumping plant and water control structures will more than offset any increased flows from accelerated runoff from the gravity outlet portion of the watershed.

After the installation of the combined program of land treatment and structural measures, the average annual acres flooded on the area where damage reduction benefits are claimed will be reduced from 1,316 to 391 acres, a 70 percent reduction. In addition, 12 of the 14 damage-producing major floods which occurred during the 20-year evaluation period, 1942 through 1961, would be reduced to minor floods. Twenty of the minor floods would be completely eliminated.

The following table discloses the reduction in flooding for selected storms within the historical series. Approximate frequencies of damage producing storms were:

Evaluation Reach (Figure 3)	Average Recurrence Interval							
	2-Year		5-Year		10-Year		20-Year	
	Without Project (acres)	With Project (acres)	Without Project (acres)	With Project (acres)	Without Project (acres)	With Project (acres)	Without Project (acres)	With Project (acres)
1	384	81	539	164	595	224	705	396
2	289	76	462	253	528	330	644	445
Total	673	157	1,001	417	1,123	554	1,349	841

In addition to the reduction in areas inundated, significant reductions will occur in the duration. The project will eliminate flooding of 48 hours or more from a 2-year frequency storm. Without project a storm of this size floods 424 acres for at least 48 hours.

Road and bridge damage will be completely eliminated from all floods up to the two-year frequency event. Larger floods will cause significantly less damage because of the reduced depth of floodwater and the shortened flood duration. Indirect damage to roads, particularly the rerouting of traffic, will be greatly reduced. Average annual road and bridge damage, including indirect damage, will be reduced 85 percent.

Protection provided by the project will improve watershed conditions so that needed drainage systems can be installed. These systems will be necessary to bring agricultural production to its full potential. There are 17,520 acres of wet soils in agricultural production that will benefit from the project. Of these, 1,349 acres are wet soils within reaches 1 and 2. The remaining 16,171 acres are expected to receive complete protection from floods up to the two-year frequency event. Floods of greater magnitude will continue to inundate parts of the areas subject to flooding under present conditions, but the depth and duration will be greatly reduced. Drainage improvements in this area will permit the use of desirable crop rotations, permit timely seedbed preparation and planting, greatly diminish the frequency and areas requiring replanting, lower production costs associated with weed and grass control, lessen the hazards due to wetness during harvest as well as increase crop yields. Crop yields are expected to increase about 15 percent.

Maintenance costs of the present drainage systems are expected to be reduced as a result of the project and management costs for those systems expected to be installed should be minimal.

The project will directly benefit 120 owners and operators of land in the benefited area.

The gross value of production per acre on the benefited area will increase from $120 to $141 (1962 prices) as a result of the project.

Secondary benefits accruing as a result of the project will be obtained in the form of increased business activity by processors and transporters of agricultural products. The expanded agricultural development will require increased purchases of items used in production and will permit an increase in expenditures for items that reflect the level of living. The value of the labor necessary to perform project construction and maintenance will also contribute to secondary activity.

The 2,350-acre area in Missouri, which drains into Ditch No. 38 through Ditch Nos. 45 and 42, is not expected to adversely affect the functioning of the structural measures included in this plan nor increase the maintenance costs.

PROJECT BENEFITS

The total estimated benefits accruing to the structural measures included in this plan will amount to $132,056 annually. Of these benefits, $115,648 are primary and $16,408 are secondary. The primary benefits accumulate from $20,444 damage reduction and $95,204 enhancement. The enhancement benefits were discounted for lag in accrual and participation. None of the benefits was derived from increased acreage of allotment or surplus crops. All benefits were converted to long-term prices, as projected by ERS, September 1957.

The estimated average annual monetary floodwater and indirect damages (table 5) in the watershed will be reduced from $29,862 to $7,521 by the proposed project. This is a reduction of 75 percent, 92 percent ($20,444) of which will result from the system of structural measures. The following table reveals the amount and location of the damage reduction benefits from all storms up to the 20-year frequency event.

Evaluation Reach (Figure 3)	Average Annual Damage: Without Project (dollars)	With Project (dollars)	Percent Reduction
1	16,349	3,154	81
2	13,513	4,367	68
Total	29,862	7,521	75

Road and bridge damage reduction benefits from structural measures are estimated to be $2,097 annually. Average annual indirect benefits will amount to $2,048.

Local secondary benefits will amount to $16,408 annually. Secondary benefits from a national viewpoint were not considered in the evaluation. Indirect benefits were excluded in calculating secondary benefits.

Damage reduction benefits resulting from land treatment measures will approximate $1,897 annually. These benefits were not used for project justification.

Since Mississippi County has not been declared eligible for assistance under ARA, redevelopments were not evaluated. However, the installation of the project will provide employment for some of the unemployed or underemployed persons in the area.

No recreation benefits were evaluated.

Crop damage reductions for selected storms in the evaluation series are presented in the following table:

Evaluation Reach (Figure 3)	Average Recurrence Interval: 2-Year Without Project (dollars)	2-Year With Project (dollars)	5-Year Without Project (dollars)	5-Year With Project (dollars)	10-Year Without Project (dollars)	10-Year With Project (dollars)	20-Year Without Project (dollars)	20-Year With Project (dollars)
1	8,180	730	13,200	170	15,080	3,300	18,770	8,550
2	7,390	1,750	12,400	6,500	14,400	8,560	17,950	11,900
Total	15,570	2,480	25,600	6,670	29,480	11,860	36,720	20,450

In addition to the benefits for which a monetary value can be assigned, there are expected to be substantial increases in opportunities to relieve underemployment, promote investments in the rural economy, provide for the expansion of locally-owned businesses, and permit shifts in agricultural resources to meet future demands. These will doubtless improve the family farm pattern of American agriculture as well as provide an increased sense of security and better living conditions. Improvements provided by the project will make possible a longer work season for migrant and local day laborers and release funds for other purposes which are normally reserved for labor payments during periods of disruption because of wetness. The structural measures will alleviate also the possible health hazards which occur as a result of stagnant water in low areas and in areas with irregular channel bottoms.

The remaining floodwater damage will occur in areas, principally in the depressions, where it is not considered feasible to provide additional protection. Normal farm operations will be possible on these areas after project installation since only 21 percent of the remaining damage will occur from floods smaller than the two-year frequency event. The remaining damage is 93 percent to crops and 7 percent to roads and bridges.

COMPARISON OF BENEFITS AND COSTS

The average annual cost of the structural measures (amortized total installation cost, plus operation and maintenance) is estimated to be $83,211. The structural measures are expected to produce average annual primary benefits of $115,684, or $1.39 for each dollar of cost. The ratio of total average annual benefits ($132,056) to the average annual cost of structural measures ($83,211) is 1.6 to 1 (table 6).

PROJECT INSTALLATION

Land treatment measures for watershed protection will be established by farmers in cooperation with the local soil and water conservation district. The soil

and water conservation district, with technical help from the Soil Conservation Service, will assist with the planning and application of these measures. Additional assistance will be provided with Public Law 566 funds to enable farmers to accelerate the planning of land treatment measures during the 5-year installation period.

The governing body of the soil and water conservation district, by scheduled meetings and individual contacts, will encourage watershed farmers to establish complete soil and water conservation programs on their farms.

The Agricultural Extension Service will assist with the educational phase of the conservation program through local meetings, radio and press releases, and other methods.

The Soil Conservation Service will provide technical assistance in planning, design, preparation of specifications, supervision of construction, preparation of contract payment estimates, final inspection, execution of certificates of completion, and related tasks for the establishment of the planned structural measures.

It is estimated that the project will require a 5-year installation period. The land treatment measures will be installed throughout the entire period. The structural measures will constitute a single construction unit. The subdistrict will obtain all land, easements, and rights-of-way for all structural measures before work is initiated on any part of the unit. All of the structural measures except the Pumping Plant will be installed during the first year. Construction will not begin on a drainage main or lateral until the channel below is completed. This sequence of construction is required so that an adequate outlet will be available for each measure when constructed. The Pumping Plant will be constructed during the second year although it is expected that engineering surveys, design and preparation of plans and specifications for the Pumping Plant will be accomplished during the first year.

The improvement district, in addition to acquiring land rights and providing funds for cost sharing in the installation of structural measures, will provide necessary legal, administrative, and clerical personnel. It will provide facilities, supplies, and equipment and will advertise, award and administer contracts.

FINANCING PROJECT INSTALLATION

Federal assistance will be provided under authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress, 68 Stat. 666), as amended. This assistance is subject to appropriation of funds.

The cost of applying planned land treatment measures will be borne by the owners and operators of the land with aid from the Agricultural Conservation

Program, the Farmers Home Administration, or other Federal and State programs.

The cost of technical assistance to the soil and water conservation district cooperators will be shared by the going Soil Conservation Service program and Public Law 566 funds.

A subdistrict, known as Subdistrict Number 2 of Drainage District Number 17 of Mississippi County, Arkansas, will be formed and will become a sponsor of the project. The subdistrict will have the power to secure and repay loans, assess benefits, and levy taxes.

A review held on January 27, 1963, of the financial status of Drainage District Number 17 revealed the following conditions for the 141,266-acre parent district:

Total Assessed Benefits	$3,201,853.25
Bonds Outstanding	243,000.00
Annual Income from Taxes from a 4-Percent Levy	128,065.30
Annual Operation Expense for Administration	14,054.00
Annual Maintenance	36,156.00

All of the outstanding bonds will mature by December 31, 1967.

Drainage District Number 17 has filed a letter of intent to borrow with the State Office of the Farmers Home Administration, Little Rock, Arkansas. The moneys obtained from the FHA loan will be used to carry out the local obligations in installing the planned structural measures. The improvement district has most of the necessary land, easements, and rights-of-way for ditch construction. Some additional land rights will be needed for enlargement, realignment, extensions, and additions to the existing system. More important to the project are those land rights needed to install the pumping plant. The needed rights will be secured, if possible, by negotiations with the owners. The district is prepared, however, to exercise its rights of eminent domain, if necessary.

PROVISIONS FOR OPERATION AND MAINTENANCE

Land treatment measures will be maintained by landowners or operators under agreements with the local soil and water conservation district. Representatives of the district and the Soil Conservation Service will make periodic inspections of land treatment measures, and the district will encourage farmers to perform needed maintenance.

The structural measures will be operated and maintained by a subdistrict which is to be legally formed and designated as Subdistrict No. 2 of Drainage District No. 17 of Mississippi County. The estimated annual operation and maintenance cost, based on long-term price levels, is

$4,350 for the channels, $8,200 for the pumping plant, $100 for the levee, and $100 for the water control structures. Funds for paying operation and maintenance costs will be obtained from taxes levied on the benefited area. Maintenance will be done with contributed labor, district-owned equipment, by contract or force account, or a combination of these methods.

The need for maintenance will be determined by inspection at least annually and as needed. Particular attention will be focused on maintaining the slope of the banks, control of vegetation, possible removal of debris, sediment accumulation, or other obstacles which would result in an abnormal reduction of channel capacities. An inspection of the outlet channel and levee will be made following each period of high flows of the Mississippi River. A full-time operator will be employed by the subdistrict to operate and maintain the pumping plant and water control structures. The stage and other conditions determining the operation of the pumping plant and water control structures will be set forth in an operation manual. This manual will be developed after the specifications have been determined during final design and will be incorporated into the operation and maintenance agreement prior to issuance of invitation to bid. The estimated annual maintenance cost of the pumping plant is $3,000. Infrequent major repairs for the diesel units are expected to constitute a large part of the maintenance cost. Provision will be made for free access of representatives of the cosponsoring local organizations and the Soil Conservation Service to inspect and for the subdistrict to provide maintenance for structural measures and appurtenances at any time.

The subdistrict will maintain a record of all maintenance inspections and maintenance performed and will make this information available to the Soil Conservation Service upon request. Drainage District Number 17 fully understands its obligation for operation and maintenance and will execute specific operation and maintenance agreements prior to any invitation to bid.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST

Crooked Lake Bayou Watershed, Arkansas

Installation Cost Item	Unit	Number to be Applied	Estimated Cost (Dollars) 1/ Public Law 566 Funds	Other Funds	Total
LAND TREATMENT					
Soil Conservation Service					
Cropland	Acre	16,000	-	296,525	296,525
Technical Assistance			11,382	10,355	21,737
SCS Subtotal			11,382	306,880	318,262
TOTAL LAND TREATMENT			11,382	306,880	318,262
STRUCTURAL MEASURES					
Soil Conservation Service					
Pumping Plant	Number	1	514,290	125,710	640,000
Drainage Mains & Laterals	Mile	37.7	187,410	56,549	243,959
Levee	Foot	1,130	33,529	8,194	41,723
Water Control Structures	Number	2	4,577	1,252	5,829
SCS Subtotal			739,806	191,705	931,511
Subtotal - Construction			739,806	191,705	931,511
Installation Services					
Soil Conservation Service					
Engineering Services			148,470	-	148,470
Other			83,533	-	83,533
SCS Subtotal			232,003	-	232,003
Subtotal - Installation Services			232,003	-	232,003
Other Costs					
Land, Easements, and Rights-of-Way			-	59,164	59,164
Administration of Contracts			-	4,222	4,222
Subtotal - Other			-	63,386	63,386
TOTAL STRUCTURAL MEASURES			971,809	255,091	1,226,900
TOTAL PROJECT			983,191	561,971	1,545,162
SUMMARY					
Subtotal SCS			983,191	561,971	1,545,162
TOTAL PROJECT			983,191	561,971	1,545,162

1/ Price Base: 1963

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TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT
(at time of Work Plan Preparation)

Crooked Lake Bayou Watershed, Arkansas

Measures	Unit	Number Applied To Date	Total Cost (dollars) 1/
LAND TREATMENT			
Conservation Cropping System	Acre	14,129	28,258
Cover and Green Manure Crop	Acre	3,000	18,750
Crop Residue Use	Acre	14,129	56,516
Grasses and Legumes in Rotation	Acre	1,496	26,479
Land Smoothing	Acre	1,480	22,200
Drainage Mains and Laterals	Foot	206,892	33,103
Row Arrangement	Acre	504	504
Spoilbank Spreading	Foot	64,922	3,895
Structures for Water Control	Number	95	13,300
Drainage Field Ditches	Foot	27,213	816
Total Land Treatment		xxx	203,821
STRUCTURAL MEASURES			
Ditch No. 38	Mile	10.42	71,560
Ditch No. 39	Mile	3.28	735
Ditch No. 40	Mile	1.19	2,835
Ditch No. 41	Mile	1.61	2,810
Ditch No. 42	Mile	4.73	8,240
Ditch No. 43 3/	Mile	3.38	10,688
Ditch No. 44	Mile	1.70	9,589
Ditch No. 45	Mile	1.29	4,119
Ditch No. 46 3/	Mile	1.72	8,366
Ditch No. 49	Mile	3.30	3,994
Ditch No. 50	Mile	.53	4,119
Ditch No. 51 3/	Mile	1.02	1,907
Ditch No. 76	Mile	1.70	3,998
Subtotal	Mile	35.87	132,960
Ditch No. 29	Mile	12.00	35,680 2/
Total Structural Measures	Mile	47.87	168,640
TOTAL ALL MEASURES		xxx	372,461

1/ Price Base: 1963.

2/ Represents only 50 percent of total expenditure on Ditch No. 29 - the portion considered applicable on a drainage area basis.

3/ These ditches are no longer a part of the watershed drainage system.

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TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Crooked Lake Bayou Watershed, Arkansas

(Dollars) 1/

Structure Site Number or Name	Installation Cost-Public Law 566 Funds				Installation Cost-Other Funds				Total Installation Cost
	Construction	Installation Services: Engineering	Installation Services: Other	Total Public Law 566 Funds	Construction	Adm. of Contracts	Easements & R/W	Total Other Funds	
Pumping Plant	514,290	96,000	57,304	667,594	125,710	2,895	-	128,605	796,199
Drainage Mains and Laterals	187,410	43,911	21,951	253,272	56,549	1,116	58,614	116,279	369,551
Levee	33,529	7,510	3,754	44,793	8,194	190	550	8,934	53,727
Water Control Structures	4,577	1,049	524	6,150	1,252	21	-	1,273	7,423
TOTAL	739,806	148,470	83,533	971,809	191,705	4,222	59,164	255,091	1,226,900

1/ Price Base 1963.

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TABLE 2A - COST ALLOCATION AND COST SHARING SUMMARY

Crooked Lake Bayou Watershed, Arkansas

(Dollars) 1/

Item	Purpose: Flood Prevention	Purpose: Drainage	Total
	COST ALLOCATION		
Multiple Purpose			
Pumping Plant, Drainage Mains and Laterals, Levee, and Water Control Structures	721,908	504,992	1,226,900
Total	721,908	504,992	1,226,900
	COST SHARING		
Public Law 566	684,612	287,197	971,809
Other	37,296	217,795	255,091
Total	721,908	504,992	1,226,900

1/ Price Base 1963.

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TABLE 3 - STRUCTURE DATA - CHANNELS

Crooked Lake Bayou Watershed, Arkansas

Channel Designation	Station Numbering for Reach: Station (100 ft.)	to Station (100 ft.)	Water-shed Area (acres)	Required Drainage Curve	Required Drainage Capacity (c.f.s.)	Planned Channel Capacity 1/ (c.f.s.)	Average Bottom Width (feet)	Average Side Slope (H/V)	Average Depth (feet)	Average Grade (ft./ft.)	Average Velocity in Channel (f.p.s.)	Volume of Excavation (1000 cu. yds.)
Ditch No. 38	50	0	12,620	Coastal	540	574	30	2:1	8.0 5/	.0001	1.56	5.7
Ditch No. 42	210	75	4,102	Coastal	212	388 3/	-	-	-	.0001	1.22	0.0
	75	49	9,180	Coastal	462	479	20	2:1	8.5	.0001	1.52	7.0
	49	0	9,517	Coastal	462	555 3/	-	-	-	.0001	1.34	7.4
Ditch No. 45	85	26	3,100	Coastal	168	183	10	2:1	7.0	.0001	1.09	23.5
	26	0	5,018	Coastal	268	267	12	2:1	8.0	.0001	1.19	6.2
Main Inlet Channel	10	0	-	-	670 2/	690	50	2:1	7.0	.0001	1.54	35.4
East Inlet Channel	390	433	-	-	265 6/	294	20	2:1	6.0	.0002	1.53	19.8
West Inlet Channel	330	390	-	-	405 6/	410	45	2:1	6.0	.0001	1.20	60.8
Connecting Ditch	186	81	-	-	150 4/	157	10	1.5:1	7.0	.0001	1.09	65.9
(Including Ditches 49 and 50)	81	0	-	-	150 4/	173	8	1.5:1	6.0	.0004	1.70	13.2
Levee, Outlet Channel, and Ditch Nos. 39, 40, 41, 43A, 44, 47, 76, and 79	-	-	-	-	-	-	-	-	-	-	-	120.6

1/ Range of "n" values (.030 - .045).
2/ Required capacity equal to design capacity of pumping plant.
3/ Portions of existing ditches adequate.
4/ Capacity required to insure comparable level of protection in Reaches 1 and 2.
5/ Elevation of hydraulic gradient at outlet - 244.1 feet (MSL).
6/ Total capacity of East and West Inlet Channels equal to design capacity of pumping plant.

Total Length - 37.7 Miles
Total Excavation - 365,533 Cubic Yards

TABLE 3A - STRUCTURE DATA - PUMPING PLANT

Crooked Lake Bayou Watershed, Arkansas

General	
Design Capacity 1/	600 c.f.s. 270,000 g.p.m. 1.7 inches/day (13.2 sq. mi.)
Maximum Static Head 2/	22.0 feet
Minimum Static Head 3/	3.8 feet
Annual Runoff Pumped	10 inches
Total Power Required	1,800 h.p. (approx.)
Pumps	
Number	3
Type	Mixed or Axial Flow
Design Capacity 1/	90,000 g.p.m. each
Size	54-inch discharge
Power Units	
Number	3
Type	Diesel
Building	
Size	64 ft. x 36 ft.
Superstructure	Steel
Foundation	Reinforced Concrete

1/ At 13 feet static head.

2/ Eighty-eight percent design flow required.

3/ Seventy-five percent efficiency required.

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TABLE 3B - STRUCTURE DATA - LEVEE

Crooked Lake Bayou Watershed, Arkansas

Structure Name	Top Width (feet)	Maximum Height (feet)	Length of Fill (feet)	Volume of Fill (cu.yd.)	Side Slopes (H/V)
Levee	14	23.3	1,130	61,691	3:1

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TABLE 4 - ANNUAL COST

Crooked Lake Bayou Watershed, Arkansas

(Dollars)

Evaluation Unit	Amortization of Installation Cost 1/	Operation and Maintenance Cost 2/	Total
Pumping Plant, Drainage Mains and Laterals, Levee, and Water Control Structures	70,461	12,750	83,211
TOTAL	70,461	12,750	83,211

1/ Price Base: 1963, installation costs amortized for 25 years at 3 percent.

2/ Price Base: Long-term prices, as projected by ERS, September 1957.

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TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Crooked Lake Bayou Watershed, Arkansas

(Dollars) 1/

Item	Estimated Average Annual Damage		Damage Reduction Benefits
	Without Project	With Project	
Floodwater			
Crop	24,176	6,404	17,772
Nonagricultural			
Road and Bridge	2,723	397	2,326
Subtotal	26,899	6,801	20,098
Indirect	2,963	720	2,243
TOTAL	29,862	7,521	22,341

1/ Price Base: Long-term prices as projected by ERS, September 1957.

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TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Crooked Lake Bayou Watershed, Arkansas

(Dollars)

Evaluation Unit	Average Annual Benefits 1/					Average Annual Cost 3/	Benefit Cost Ratio
	Flood Prevention		Agricultural Water Management				
	Damage Reduction	More Intensive Land Use	Drainage	Second-ary	Total		
Pumping Plant, Drainage Mains and Laterals, Levee, and Water Control Structures	20,444	47,602	47,602	16,408	132,056	83,211	1.6:1
GRAND TOTAL	20,444 2/	47,602	47,602	16,408	132,056	83,211	1.6:1

1/ Price Base: Long-term prices as projected by ERS, September 1957.

2/ In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of $1,897 annually.

3/ From table 4.

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INVESTIGATIONS AND ANALYSES

LAND TREATMENT

The conservation needs inventory for Mississippi County recently completed by the United States Department of Agriculture, under the leadership of the Soil Conservation Service, provided information on land capabilities. With this information and the work unit technical guides, the conservation needs for the watershed were developed.

Land treatment measures already applied and the cost per unit of application for each measure were obtained from farm operators and work unit records. This information was used in preparing the land treatment portion of table 1A.

Land treatment measures to be applied during the project installation period were determined on the basis of the personnel available for planning, funds available for ASCS cost sharing, interviews with farm operators to determine resources available for installing land treatment measures, and the amount of treatment measures needed to insure the accrual of benefits used in project justification.

ENGINEERING AND HYDRAULICS

Channels

The ditch system, as proposed in this plan, was established by Drainage District No. 17 of Mississippi County. Some minor revisions and extensions of existing ditches will be made. The district provided cross sections and profiles of existing ditches from their available data. Surveys were made by the district of all appurtenant bridges and culverts. The district also surveyed cross sections on Ditch Nos. 38, 42, and 45 at intervals not exceeding one mile. A profile of Ditch No. 43A, which is a relocation of existing Ditch No. 43, was surveyed by personnel of the work plan party. A topographic map with a 1-foot contour interval was developed by a planetable survey of Reach 1 and the area on which the pumping plant and outlet channel are to be located. A similar map for Reach 2 was developed from surveys conducted by the drainage district engineer. Additional topographic data was obtained from Corps of Engineers quadrangle maps.

The local sponsors furnished the information as to the ownership in the watershed. Locations of the proposed ditches were drawn on the ownership mosaic to insure that all proposed improvements would serve at least two landowners. A check was made to determine that laterals would not result primarily in bringing new land into production.

All mains and laterals were designed for multiple-purpose use (flood prevention and drainage), using the formula, $Q = CM^{5/6}$, where:

Q = required ditch capacity in cubic feet per second,

C = coefficient,

M = drainage area in square miles.

The value of "C" was determined to be 45. This is the coastal curve shown in Figure 66, Chapter 6, National Engineering Handbook, Section 16.

The quantity and cost estimates of the designed mains and laterals were expanded to include the remaining ditches.

Pumping Plant System

An investigation was made to determine the need for a pumping plant to meet the objectives of the local cosponsoring organizations.

Using a rating curve of the Little River Floodway, developed for modified conditions by the Corps of Engineers and developing water surface profiles up to the outlet of Ditch No. 38, a stage-discharge curve was developed at the outlet of the watershed. This curve was used to determine that Ditch No. 29 could provide an adequate outlet for approximately 19.7 square miles of the watershed. The required outlet capacity was figured using the runoff formula, $Q = 45M^{5/6}$. The installation of a pumping plant will provide an adequate outlet for the remaining 13.2 square miles of the watershed.

Field examinations were made of three alternates for the pumping plant location. The first location considered was at the outlet of Ditch No. 38. A plant at this location would have lower lifts than a plant that would discharge over the levee into the Mississippi River. However, this plant would have high discharge rates over long periods of time and would increase flooding along Ditch No. 29.

The other two locations were at the levee. One was at River Styx and the other was at the proposed location (figure 3). The present location was chosen over the River Styx location because it is nearer the centroid of the depressions, and because survey investigations indicated that the selected location has better foundation conditions.

The plant capacity was determined by adjusting information obtained by Anderson and Moore in Louisiana and Texas and stated on page 36 of U.S.D.A. Technical Bulletin 1008. This data was adjusted on the basis of the variation of the 24-hour storm, 2-year frequency (U.S.W.S. Technical Paper 40) between Arkansas and Louisiana.

The Soil Conservation Service entered into a contract with a consulting engineer to provide preliminary plans for the pumping plant. The Soil Conservation Service provided the following items:

1. The quantity of water to be pumped (270,000 g.p.m.).

2. Maximum static head (22 feet) difference between maximum recorded stage of Mississippi River and optimum stage of Intake Bay.

3. Average static head (3.5 feet) average monthly lifts weighted according to amount of runoff pumped in the respective months.

4. Design static head (13 feet) approximate 2-year maximum static head.

5. Recommendation of number of pumps, three units with study of other multiple-unit stations.

6. Frequency of pump operation, average annual pumping time, and hours of operation at various heads.

7. Topographic map of pumping plant site and designs of inlet and outlet channel.

8. Preliminary subsurface investigations at pumping plant location.

The consulting engineer agreed to:

1. Make a determination of location and arrangement of the pumping station and appurtenant piping and structures at the site selected by the Soil Conservation Service.

2. Make a selection of the number and type of pumps to be utilized.

3. Determine power source for pumping units.

4. Prepare a preliminary design of pump discharge lines.

5. Prepare a preliminary design of pumping station and outlet structure.

6. Make detailed hydraulic computations for priming and for minimum and maximum static lift conditions.

7. Prepare a composite discharge-static lift curve.

8. Make detailed estimates of initial capital cost and annual operating and maintenance costs.

The consulting engineer has submitted his report entitled, "Preliminary Design Report, Crooked Lake Bayou Pumping Station, Mississippi County, Arkansas", prepared for the United States Department of Agriculture, Soil Conservation Service, Little Rock, Arkansas, and dated January 1964.

Other structural measures which are planned to complete the pumping plant system are the inlet and outlet channels and levee, the connecting ditch, and two water control structures.

The inlet and outlet channels are planned to carry the designed capacity of the pumping plant. The levee was designed to an elevation equal to that of the old levee which is to be cut. The design elevation is above the 100-year frequency elevation of the Mississippi River.

The connecting ditch was designed to carry 150 c.f.s. with the hydraulic gradient at the upper end of the ditch set at the approximate 5-year frequency water level in Reach 2. It will assure Reach 2 a level of protection comparable to Reach 1. Profiles of the inlet and outlet channels and the connecting ditch were surveyed.

Water Control Structure Nos. 1 and 2 were designed for use in regulating the flow of water between Reach 1 and Reach 2. The design capacity of Structure No. 2 is 150 c.f.s. The capacity of Structure No. 1 is based on the design flow in Ditch No. 38 at the location of the structure. The water control structures will be manually controlled.

HYDROLOGIC

Basic Data Available

Rainfall records at Blytheville, Arkansas are for the period 1931 through 1962. Modified stage-frequency curves on the Little River Floodway at Pettyville, Arkansas and gage records on the Mississippi River at the Obion gage were obtained from the Memphis District of the Corps of Engineers.

Soil cover conditions, with and without project, were estimated with the help of the area and work unit conservationists.

Estimating Flood Losses

The procedures used in evaluation of Crooked Lake Bayou are outlined as follows:

1. General

    a. A 20-year historical series was tabulated from the 32 years of rainfall records at Blytheville, Arkansas. Based on cumulative departures from normal, the period 1942 through 1961 was selected as a period of most normal rainfall.

    b. Soil cover complex data were assembled to compute runoff curve numbers. Consideration was given to factors such as soils, relief, and cover conditions in this determination. These curve numbers, combined with antecedent soil moisture conditions, were used in computing runoff from the storms in the

historical series for both with and without project.

c. Water surface profiles were computed from the Corps of Engineers rating curves on the Little River Floodway to the outlet of each reach. The profiles were derived by Doubt's Method (Section 3.14, National Engineering Handbook 4, Supplement A). No out of channel flow was considered below the reaches. The channels as improved in 1958 were used for computations.

d. Triangular hydrographs were computed using the method outlined in Section 3.16, National Engineering Handbook 4, Supplement A, with 24-hour duration storm. Peaks were determined from information gathered on other delta watersheds. Routings were made to determine the effects of the pumping plant, with and without channel improvements.

2. Without Project

a. Flood routings were made using graphical method two outlined in the National Engineering Handbook, Section 5.8.4. Stage-discharge curves were taken from water surface profiles. Stage-storage curves were developed from topographic surveys. Routings were made with 1.0, 2.37 (2-year frequency from TP-40 with antecedent moisture condition II), 4.0, and 6.0 inches runoff. For routing purposes, a positive block was assumed in Ditch No. 38 and in the connecting ditch so that the drainage areas could be determined accurately.

b. Runoff-peak discharge was determined for each reach. Runoff-area inundated relationships were established from the rating curves and stage-area inundated curves.

c. Duration analysis was made based on the temporary storage curves developed in the graphical routing. Acres inundated for each duration interval were determined from the stage-storage and stage-area inundated curves.

3. With Project

a. Two future routings were made in Reach 2. The first routing was made with the installation of the pumping plant. This routing was varied from without project by adjusting water surface profiles based on reduced drainage area caused by pumping Reach 1. The second routing was made with the pumping plant installed and channel improvements in Ditch Nos. 38 and 42.

One future routing was made in Reach 1. This routing was made with a stage-discharge curve developed from approximate pump discharges. Discharges were computed at 13 feet static lift which

is the approximate 2-year maximum lift.

b. In Reach 1, runoff-peak storage was determined from the routings and runoff-area inundated relationships were developed from stage-storage and stage-area inundated curves. In Reach 2, runoff-peak discharge was determined from the routing and runoff-area inundated relationships were developed from the rating curves and stage-area inundated curves. Duration analysis was made by the same method as in the without project routings.

Pumping Plant Operation Analysis

Frequency of operation, average annual pumping time and hours of operation at various heads were computed and given to the private engineer for his operation and maintenance cost analysis. Frequency of operation and average annual pumping time were computed from all runoff-producing storms in the historical series. Hours of operation at various heads were computed from correlation of runoff and static lift by seasons using an annual runoff pumped of ten inches.

SEDIMENTATION

Field investigations involved sufficient observations to determine that sedimentation is not a serious problem in the watershed. Usual maintenance of the channel system will be sufficient to eliminate sediment bars which may accumulate at the mouths of the laterals during the life of the system.

GEOLOGIC

Recommendations made on optimum depth and side slopes for channels were based on experience in the area, supported by published well logs and geologic reports and maps. Additional information on ground water was obtained from Water Resources Circular Number 7.

The watershed is underlain by deposits of Quaternary Age. These alluvial deposits vary from about 100 feet to 200 feet in thickness. This variation in thickness is due to the configuration of the present land surface and the configurations of the erosional surface on which they were deposited.

These deposits were laid down by the modern Mississippi River and its tributaries. They are lithologically similar to deposits of Quaternary Age on other parts of the alluvial valley in Arkansas and consist of coarse sand and gravel at the base grading upward through finer sand to silt or clay at the top. This general sequence of deposition has been modified by the relatively recent shifting (1837, 1843, and 1847) of the Mississippi River. This reworking has made the material more variable in size gradations and physical characteristics. In general, silt and clayey silt (ML and CL material of the Unified Soil Classification) can be expected for the first 20 to 25 feet below the ground surface. Beneath this silty material will be found fine to very fine sands and silty sands (SP and SM of the Unified Soil

Classification). These materials will have poor to good bearing characteristics depending upon compaction and ground water levels.

The New Madrid Earthquake, which occurred in 1811 and 1812, affected northeastern Arkansas, southeastern Missouri, and northwestern Tennessee. During the period of earthquakes, the alluvial materials of the river valley were mixed by the seismic activity. Consequently, some of the soil and subsoil materials in Mississippi County do not fit a logical sequence or pattern of alluvial deposition.

Near the outlet of Ditch No. 38 into Pemiscot Bayou in the northwestern corner of the watershed, soils along the ditch reduce channel capacity of the ditch by sloughing. The surface soil material is clayey and the subsoil material is sandy and silty. The ground water table occurs generally at a depth of about five feet below the land surface and the elevation of the water table fluctuates seasonally. The fluctuating water table causes the sandy subsoil to become unstable and flow into the ditch. This movement takes away the support for the overlying clayey soil, causing it to slough off and add more sediment to the ditch. Recommendations for the solution of the problem were made for engineering designs of the ditch. Additional ditch width in place of substantial increase in depth provides the best solution for the unstable condition.

Six drill holes were drilled in the vicinity of the planned pumping plant location. These supplied geologic information to be used in the design of the pumping plant. Materials were logged by the Unified Soil Classification System and blow counts were taken to indicate the strength of the subsoil materials. Well permeameter tests were conducted in three drill holes and determined the site is adequate. Geologic information afforded by these drill holes and tests was supplied to the private engineering firm which designed the pumping plant.

More detailed investigations and laboratory testing of soils will be carried out prior to final design of the project.

ECONOMIC

Agricultural damage estimates were based on field schedule information obtained from landowners and operators in Crooked Lake Bayou watershed. Information collected in the field included the present land use, crop distribution and yields, restrictions and limitations in crop distribution and cultural practices because of flooding and inadequate outlets, probable shifts in crop distribution after project installation of on-farm drainage systems, and information pertaining to trends in agricultural production and mechanization. Information was also collected to determine the frequency of flooding, severity and extent of crop damage, causes of flood damage (whether by depth or duration), and the extent and location of other agricultural and nonagricultural damages.

Extensive sampling was considered necessary, in view of the nature, diversity, and location of watershed problems, to determine the amount and effectiveness of drainage improvements already installed in the watershed and the type of evaluation required to measure the floodwater damages. The sample covered about 70 percent of the agricultural units in the two depression areas and about 40 percent of the units elsewhere in the watershed.

The field investigation showed that significant floodwater damages could be evaluated in the two depression areas but the effects of flooding and inadequate drainage were inseparable outside of these areas. The two depression areas were designated as Evaluation Reaches 1 and 2 and the land use therein was mapped in detail.

Because of the necessity to measure crop damages with reference to crop seasons and adjust damages for recurrent flooding, the historical method of evaluation was used.

In calculating crop damage, the cost of harvesting and other production inputs were deducted from the gross value of the damage. Estimates of flood-free yields were based on data obtained from schedules, supplemented by information from other agricultural workers in the area and from other secondary sources. Because field investigations revealed that crop damages were affected more by duration of inundation rather than depth, the Supplement to Economics Memorandum AK-108 was used to obtain the damage factors for evaluation purposes. Adjustments were made in the damage curves to reflect the low value of production on land adjacent to the channels.

Road and bridge damage was the only type of nonagricultural damage occurring in the watershed indicated by the damage schedules. Damages were estimated on the basis of information describing the physical damage by non-velocious floodwater on roadbeds and surface material. Records disclosing the amount of public funds expended for road repairs within the watershed were not available.

Indirect damages associated with agricultural and nonagricultural activities include the interruption of travel or detours for local farmers and public servants, losses sustained from the inability to gain access to fields to perform normal farm operations, and additional expense connected with the delayed rate of harvest and the timely removal of farm products to market. In view of the fact that the interruptions, detours, and delayed operations occur for lengthy periods, it was estimated that indirect damages would be at least 10 percent of the direct damages from cropland and 15 percent of the direct road and bridge damage.

Field investigations disclosed that sediment deposition and scour damage were not significant problems within the watershed.

Benefits from Reduction in Damages

Average annual damages were calculated separately for conditions without a project, with planned land treatment measures installed, and with the system of structural measures. The difference between the damage remaining after the installation of each phase of the project and the damage before its installation constitutes the benefits creditable to that phase. This formed the basis on which damage reduction benefits were assigned to the measures producing them. Adjustments for recurrent flooding were made in the crop damage after each increment of evaluation. The conversion to long-term prices for both agricultural and nonagricultural damages was made after each increment of evaluation.

It is recognized that the installation of the pumping plant will make possible some benefits outside the watershed. These will result from the shortened inundation period on land draining into Ditch No. 29 and will occur by virtue of a reduction in drainage area served by Ditch No. 29. This is the area to be pumped. These benefits were not evaluated in monetary terms.

Enhancement Benefits

Farmers were asked what changes would be made in farming operations if flooding were reduced and drainage were provided. It was their opinion that if the proposed improvement would hasten the removal of water from the evaluation reaches and provide normal drainage protection on wet lands they could obtain the yields that are being obtained on similar soils where drainage improvements have been made.

Estimates of enhancement benefits on the 17,520 acres of wet soils were based on the expected increases in yields on present cropland, and the expected shifts in crop distribution after project installation. The crop distribution and yield data collected on similar soils in drained areas were used as a basis for determining crop yields on the area benefiting from the project. Crop yields in the area outside the evaluation reaches under project conditions, were adjusted downward slightly to account for the effect seepwater has on reducing yields. Seepwater has no detrimental effect on crop yields within the evaluation reaches due to the nature of the soils. Consideration also was given to the effect of flood events for which the project will not provide full protection.

All of the enhancement benefits were considered inseparable and, consequently, were allocated equally to flood prevention and drainage. None of the benefits was derived from increased acreage of allotment or surplus crops. Associated costs were deducted from the gross benefits to obtain the net benefits. Enhancement benefits were discounted 20 percent to account for the expected incomplete participation in on-farm drainage systems. Benefits were further discounted to allow for a five-year buildup to their full level. This made a total discount of 30.9 percent. Appropriate items

of associated costs were likewise discounted by this amount. Project benefits were adjusted to allow for the effect of existing drainage improvement.

Enhancement benefits are summarized in table A.

Secondary Benefits

The analysis of secondary benefits was based on primary benefits stemming from the project, together with increased costs of producing the additional goods induced by the project. A factor of 10 percent, as set forth in Watershed Memorandum SCS-57, was used in each case.

Project Costs

Amortization factors used in evaluating project cost were determined on the basis of the expected performance of maintenance and the likelihood of the structural measures remaining adequate to meet the agricultural needs of the future. Installation costs were amortized for 25 years. Operation and maintenance costs were converted to 1957 long-term price levels, as projected by ERS, September 1957.

Engineering services cost for the pumping plant was estimated to be 15 percent of the construction cost. This was considered sufficient in view of the engineering and geologic investigations conducted at the pumping plant site during planning. All other engineering and other engineering services costs were computed as set forth in Watershed Memorandum AK-13.

Project costs were allocated to purposes in accordance with the second alternate under paragraph 1132.212 of the Watershed Protection Handbook. Cost sharing was done in accordance with procedures set forth in the policy of the Secretary of Agriculture.

The cost data used to develop the structural measures portion of table 1A were furnished by the engineer for Drainage District No. 17. The portion of the costs that might be considered maintenance could not be correctly determined; consequently, all of the costs were considered. These costs include those expended from 1950 to 1962, inclusive. For purposes of table 1A only half of the cost of improvements on Ditch No. 29 was included. This was the portion considered applicable to the watershed on a drainage area basis. Engineering News Record indexes were used to convert these costs to the 1963 price base so they could be compared with the costs used in table 1.

Table A - Summary of the Evaluation of Enhancement-Type Benefits in the Benefited Area

Crooked Lake Bayou Watershed, Arkansas

Land Use	Unit of Production	Acres	Without Project: Yield Per Acre	Without Project: Gross Income (dollars)	Without Project: Production Costs (dollars)	Without Project: Net Return (dollars)
Cotton	Lb. Lint	7,195	510	1,181,563	833,181	348,382
Cottonseed	Ton		.459	161,451	-	161,451
Soybeans	Bu.	9,375	28	616,875	226,875	390,000
Alfalfa	Ton	950	3.8	79,312	39,278	40,034
Wheat	Bu.	(740)	40	57,720	14,852	42,868
Total		17,520		2,096,921	1,114,186	982,735

Land Use	Unit of Production	Acres	With Project: Yield Per Acre	With Project: Gross Income (dollars)	With Project: Production Costs (dollars)	With Project: Net Return (dollars)
Cotton	Lb. Lint	7,195	600	1,390,074	905,059	485,015
Cottonseed	Ton		.540	189,899	-	189,899
Soybeans	Bu.	9,375	34	749,062	243,754	505,308
Alfalfa	Ton	950	3.8	79,312	39,278	40,034
Wheat	Bu.	(740)	40	57,720	14,852	42,868
Total		17,520		2,466,067	1,202,943	1,263,124

Increased Net Return With Project - 1963 Prices	280,389
Increased Net Return With Project - Long-Term Prices	280,100
Discounted Increased Net Return (Gross Benefit)	193,549
Less Associated Cost	24,748
Less Benefits from Drainage Already Installed	73,597
Average Annual Benefits	95,204

January 1964

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Table B - Summary of Cost Allocation and Cost Sharing

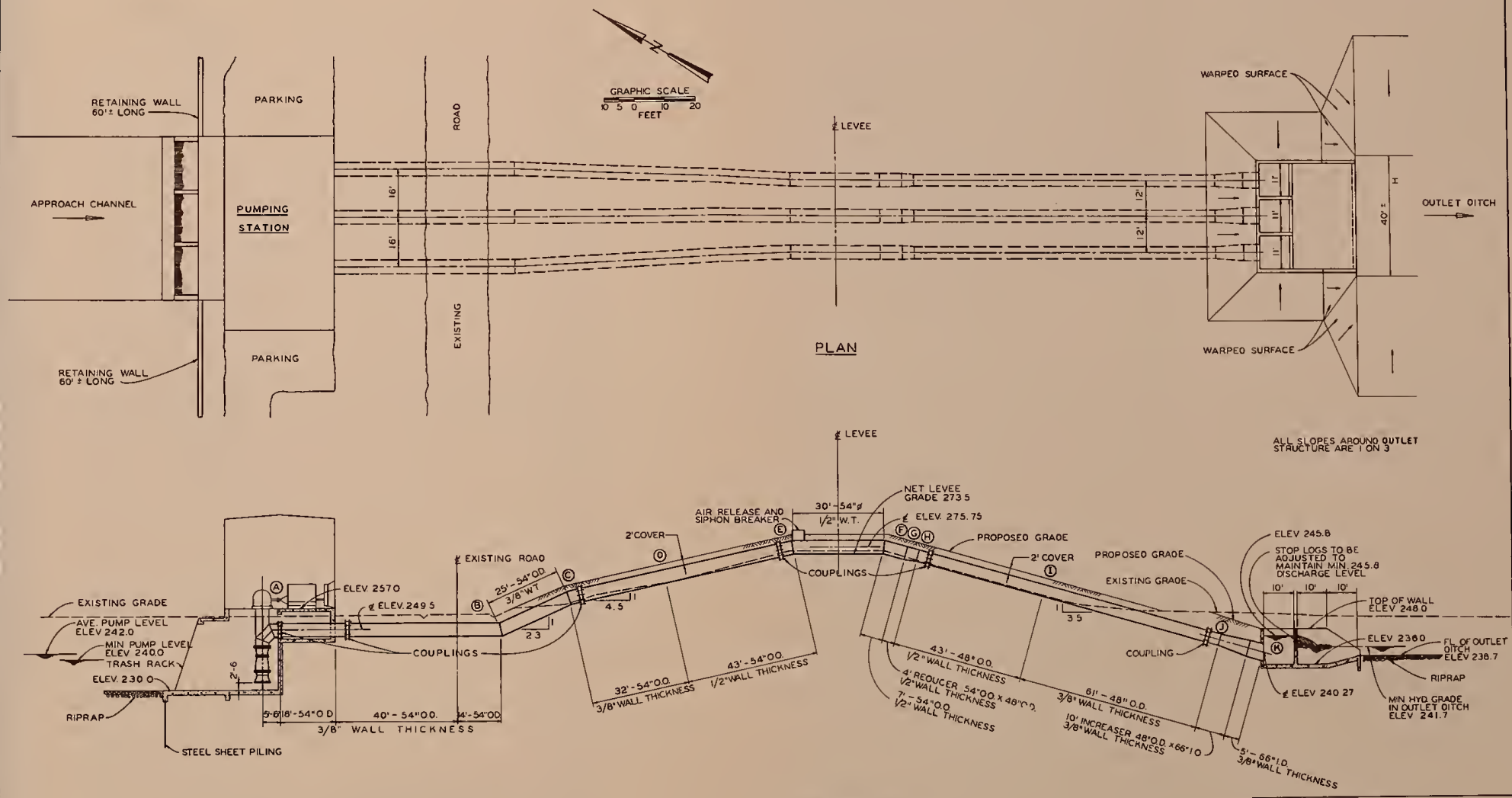
Crooked Lake Bayou Watershed, Arkansas

(Dollars) 1/

Structure Name or Number	Flood Prevention			Drainage			Total	Recapitulation	
	Public Law 566	Other	Total	Public Law 566	Other	Total		Public Law 566	Other
Pumping Plant, Drainage Mains and Laterals, Levee, and Water Control Structures									
Engineer's Estimate	496,615	-	496,615	174,277	174,277	347,394	844,010	670,892	174,277
Contingencies	51,486	-	51,486	17,428	17,428	36,016	87,501	68,914	17,428
Construction	548,101	-	548,101	191,705	191,705	383,410	931,511	739,806	191,705
Engineering Services	87,360	-	87,360	61,110	-	61,110	148,470	148,470	-
Other Installation Services	49,151	-	49,151	34,382	-	34,382	83,533	83,533	-
Easements and Rights-of-Way	-	34,812	34,812	-	24,352	24,352	59,164	-	59,164
Administration of Contracts	-	2,484	2,484	-	1,738	1,738	4,222	-	4,222
Total Installation Cost	684,612	37,296	721,908	287,197	217,795	504,992	1,226,900	971,809	255,091
Percent to Purpose			58.84			41.16	100.00		
Percent Cost Sharing	94.83	5.17	100.00	56.87	43.13	100.00	100.00	79.21	20.79

1/ Price Base 1963.

January 1964



TYPICAL SECTION

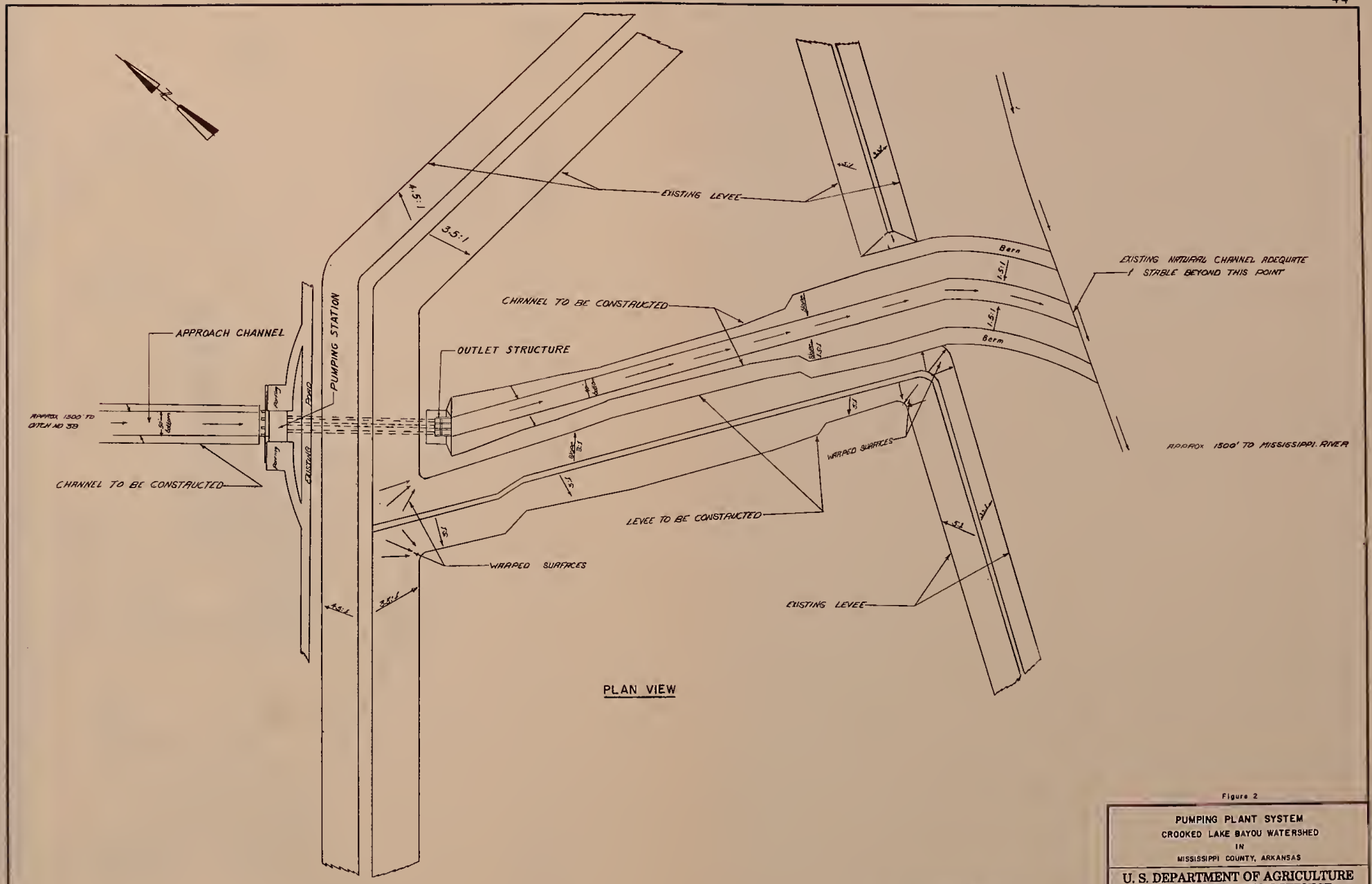
Figure 1
PLAN AND TYPICAL SECTION

CROOKED LAKE BAYOU PUMPING STATION
MISSISSIPPI COUNTY, ARKANSAS

UNITED STATES
DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

1-64 4-R-18558

Rev. 3-64



PLAN VIEW

Figure 2

PUMPING PLANT SYSTEM
CROOKED LAKE BAYOU WATERSHED
IN
MISSISSIPPI COUNTY, ARKANSAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed R. E. Sullivan
Drawn Asst. Draftsman
Traced Bob Bush
Checked

Date
Approved by
Title
Sheet No. 1 of 1
Drawing No. 4-E-18569

Rev. 3-64

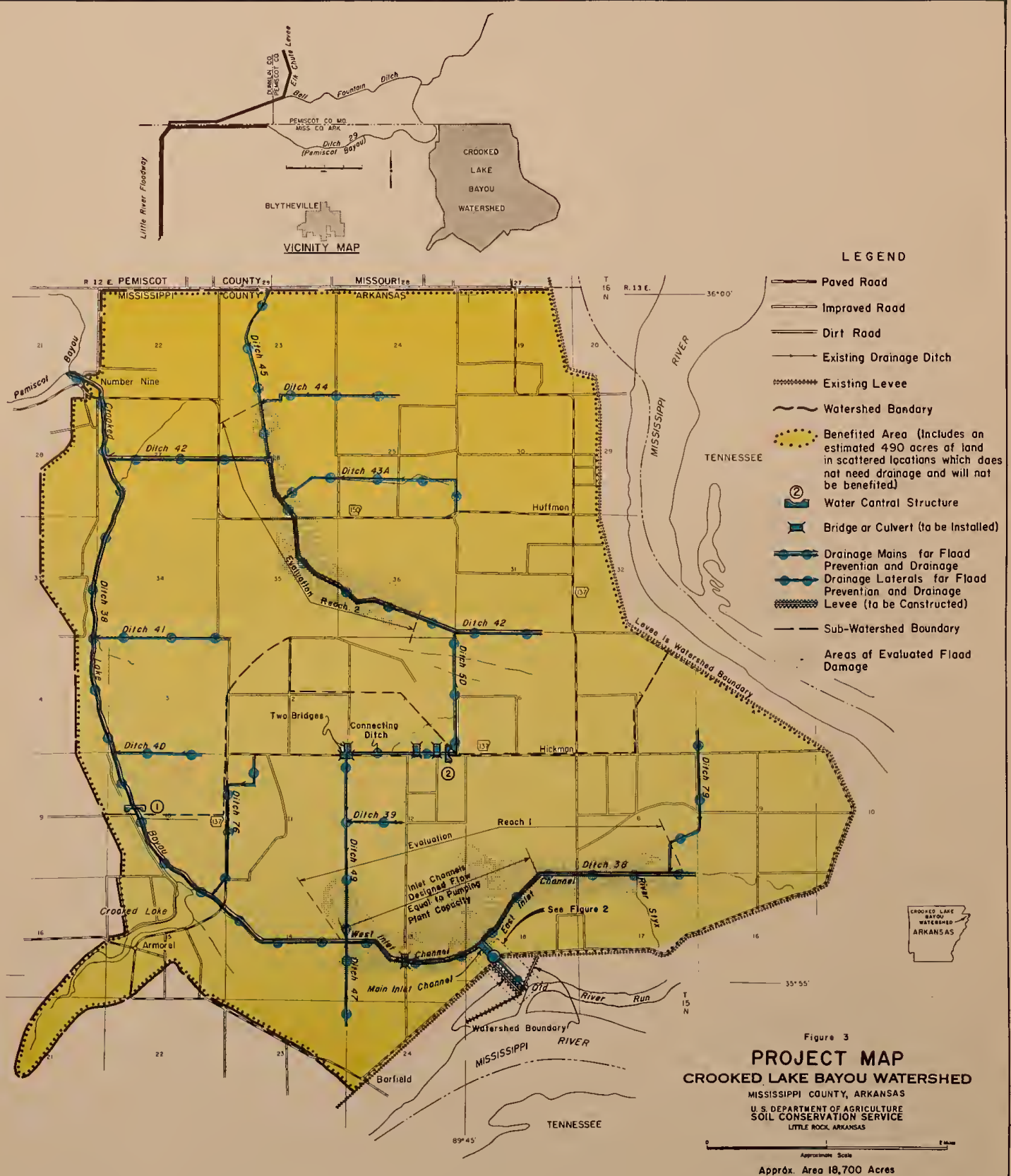


Figure 3

PROJECT MAP

CROOKED LAKE BAYOU WATERSHED

MISSISSIPPI COUNTY, ARKANSAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
LITTLE ROCK, ARKANSAS

Approximate Scale

Appróx. Area 18,700 Acres

Base Compiled From Uncontrolled Mosaic No 4-R-16612

4-17-62

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Revised 3-64 4-R-16613